MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

DIM5058 – MATHEMATICAL TECHNIQUES 1

(For DIT students only)

15 MARCH 2019
03.00 pm – 05.00 pm
(2 Hours)

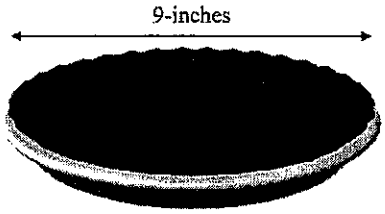
INSTRUCTIONS TO STUDENT

1. This question paper consists of **4** pages (**2** pages with **4** questions and **2** pages of Appendix). Key formulae are given in the Appendix.
2. Answer **ALL** questions.
3. Write your answers in the answer booklet provided.
4. All necessary working steps must be shown.

QUESTION 1

a) Given $\sin\theta = -\frac{5}{13}$ and $180^\circ \le \theta \le 270^\circ$, find the value of $\cot\theta$. (3 marks)

b) Madam Maria baked a round of chocolate pie in a 9-inch pie pan. She cuts the pie into six equal pies so that everyone gets the same sized piece.
(Use $\pi = 3.142$)



i) Determine the central angle created by two pieces of pie, in radian. (1 mark)

ii) Determine the length of arc of the two pieces of pie, in inch. (1.5 marks)

iii) Determine the circumference of the original pie, in inch. (2.5 marks)

c) If $\tan\theta = \frac{1}{\sqrt{2}}$, find $\csc\theta$ using Pythagorean Identities. Assume θ is an acute angle. (3 marks)

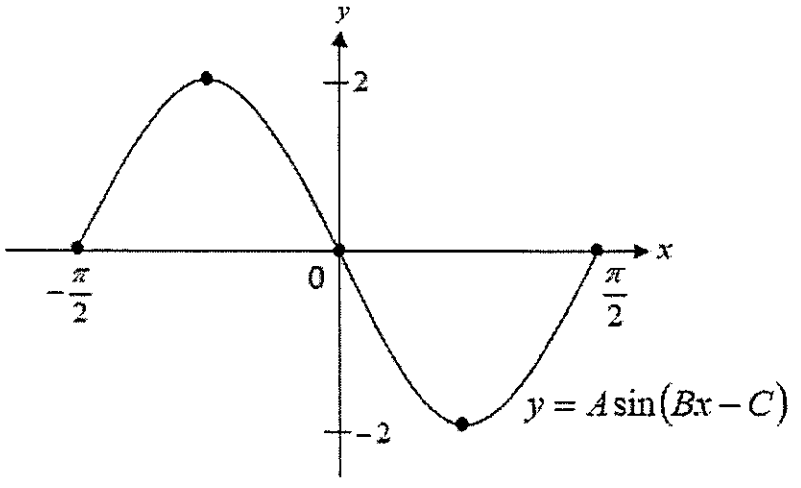
d) Let $P = (3,-2)$ be a point on the terminal side of θ. With the aid of diagram, compute $\sin\theta$. (4 marks)

[TOTAL 15 MARKS]

QUESTION 2

a) Sketch and label completely for $y = -3\cos\left(x - \frac{\pi}{2}\right)$, $0 \le x \le 2\pi$. (5 marks)

b) Based on the graph below, find the amplitude, period and phase shift. Thus, rewrite the function in the form of $y = A\sin(Bx - C)$. (5 marks)



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[TOTAL 10 MARKS]

QUESTION 3

a) Solve the given matrix equation to obtain the values of a, b and c. (5 marks)

$$4\begin{pmatrix}1+2a\\2-3b\\3-c\end{pmatrix}+\begin{pmatrix}-6\\12\\36\end{pmatrix}=-3\begin{pmatrix}2a & 6b & 4c\end{pmatrix}^T$$

b) The currents running through an electrical system are given by the following system of equations. The three currents, I_1, I_2, and I_3, are measured in amps. Find the difference between I_3 and I_2 currents in this circuit.
(Hint: **Use Cramer's Rule**) (8 marks)

$$I_1+2I_2-I_3=0.425$$
$$3I_1-I_2+2I_3=2.225$$
$$5I_1+I_2+2I_3=3.775$$

[TOTAL 13 MARKS]

QUESTION 4

a) Find the sum of the sequence $\sum_{a=2}^{5}\frac{1-a}{2^a}$ and represent your answer in fraction form. (2.5 marks)

b) Given the first term of an arithmetic sequence is 5, and common difference is 3. Show that the sum of the 10^{th} and 20^{th} terms of the sequence is equal to 94. (1.5 marks)

c) The sum to infinity of a geometric sequence is -8. If the first term is -4, find the common ratio. Hence, find the sum of the first 6 terms. (3 marks)

d) Find the 4^{th} and 7^{th} term of the expansion $(x^3-3y)^{10}$. (5 marks)

[TOTAL 12 MARKS]

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APPENDIX – KEY FORMULA

Trigonometric functions

$y = A\sin(Bx - C)$ or $y = A\cos(Bx - C)$

Amplitude = $|A|$, Period = $\frac{2\pi}{B}$, and Phase Shift = $\frac{C}{B}$.

Determinant of a 2 × 2 matrix	*Determinant of a 3 × 3 matrix*
$\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = a_1b_2 - a_2b_1$	$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$ $= a_1\begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - b_1\begin{vmatrix} a_2 & c_2 \\ a_3 & c_3 \end{vmatrix} + c_1\begin{vmatrix} a_2 & b_2 \\ a_3 & b_3 \end{vmatrix}$

Inverse of a 2 × 2 matrix
If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, then $A^{-1} = \frac{1}{ad - bc}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$, where $ad - bc \neq 0$.

Cramer's Rule for 2 × 2 matrix	*Cramer's Rule for 3 × 3 matrix*
If $\begin{aligned} a_1x + b_1y &= c_1 \\ a_2x + b_2y &= c_2 \end{aligned}$ then $x = \frac{\begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}$ and $y = \frac{\begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}$, where $\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} \neq 0$	$\begin{aligned} a_1x + b_1y + c_1z &= d_1 \\ \text{If } a_2x + b_2y + c_2z &= d_2 \\ a_3x + b_3y + c_3z &= d_3 \end{aligned}$ then $x = \frac{D_x}{D}, y = \frac{D_y}{D}, z = \frac{D_z}{D}$ where $D = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$, $D_x = \begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix}$, $D_y = \begin{vmatrix} a_1 & d_1 & c_1 \\ a_2 & d_2 & c_2 \\ a_3 & d_3 & c_3 \end{vmatrix}$, $D_z = \begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix}$

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Arithmetic sequence	*Geometric sequence*
$a_n = a_1 + (n-1)d$	$a_n = a_1 r^{n-1}, S_n = \frac{a_1(1-r^n)}{1-r}$
$S_n = \frac{n}{2}(a_1 + a_n)$	$S_\infty = \frac{a_1}{1-r}, \lvert r \rvert < 1$

Binomial Theorem

$$(a+b)^n = \sum_{k=0}^{n} \binom{n}{k} a^{n-k} b^k; \quad n \geq 1$$

The r^{th} term of the expansion of $(a + b)^n$ is $\binom{n}{r-1} a^{n-r+1} b^{r-1}$.

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